

Participatory modelling for conceptual system dynamic model of social- ecological system in Bangladesh delta

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The notion on social-ecological system and the sustainability science concepts (e.g. tipping points, interaction, feedbacks) rapidly gained ground over the past decades

Ecosystem management requires understanding of the social-ecological system in an integrative way-

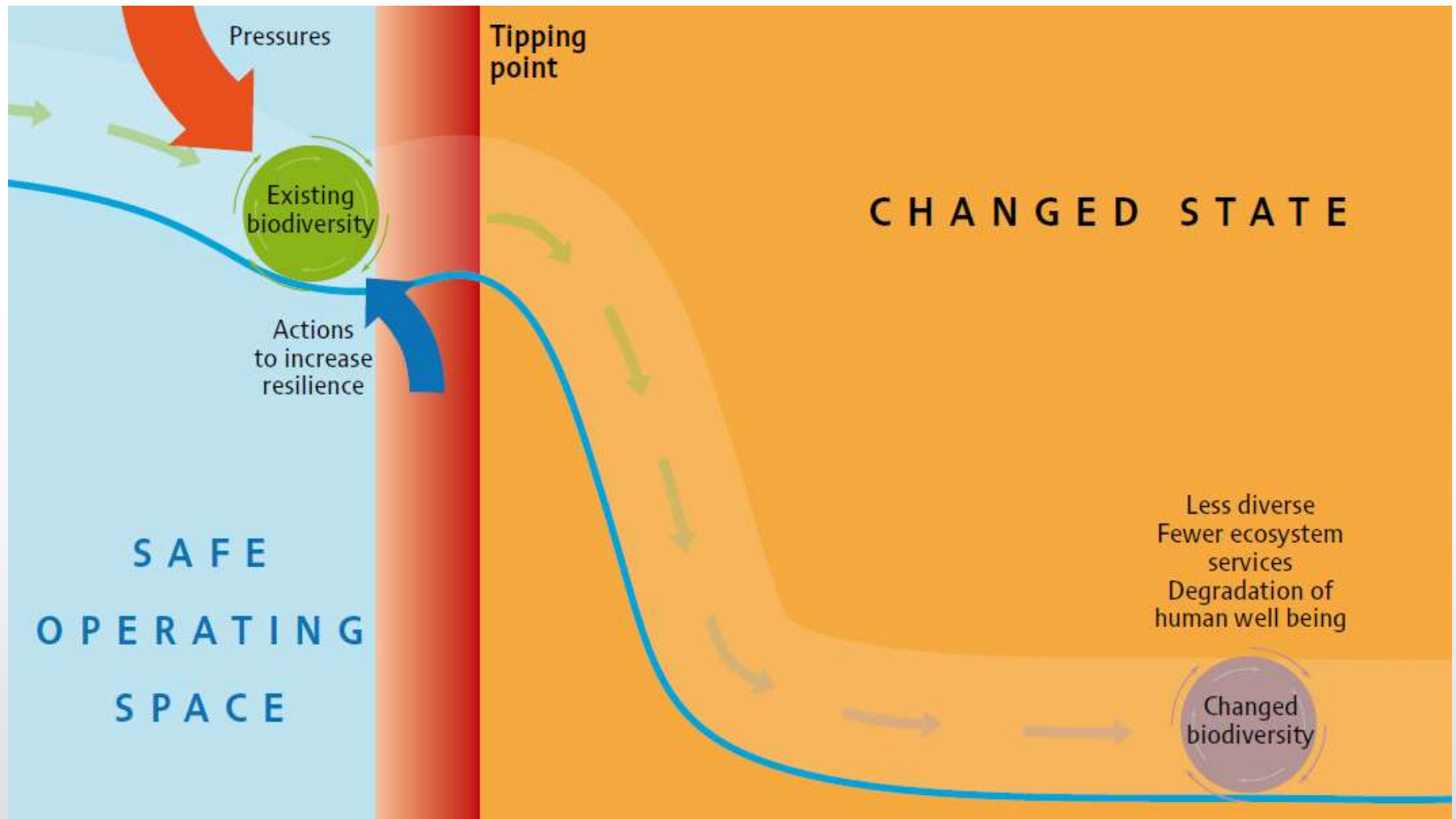
A systems perspective can be used to synthesize all these complex concepts (e.g. lags)

(Hossain et al., 2015; Liu et al., 2007; Folke et al., 2005)



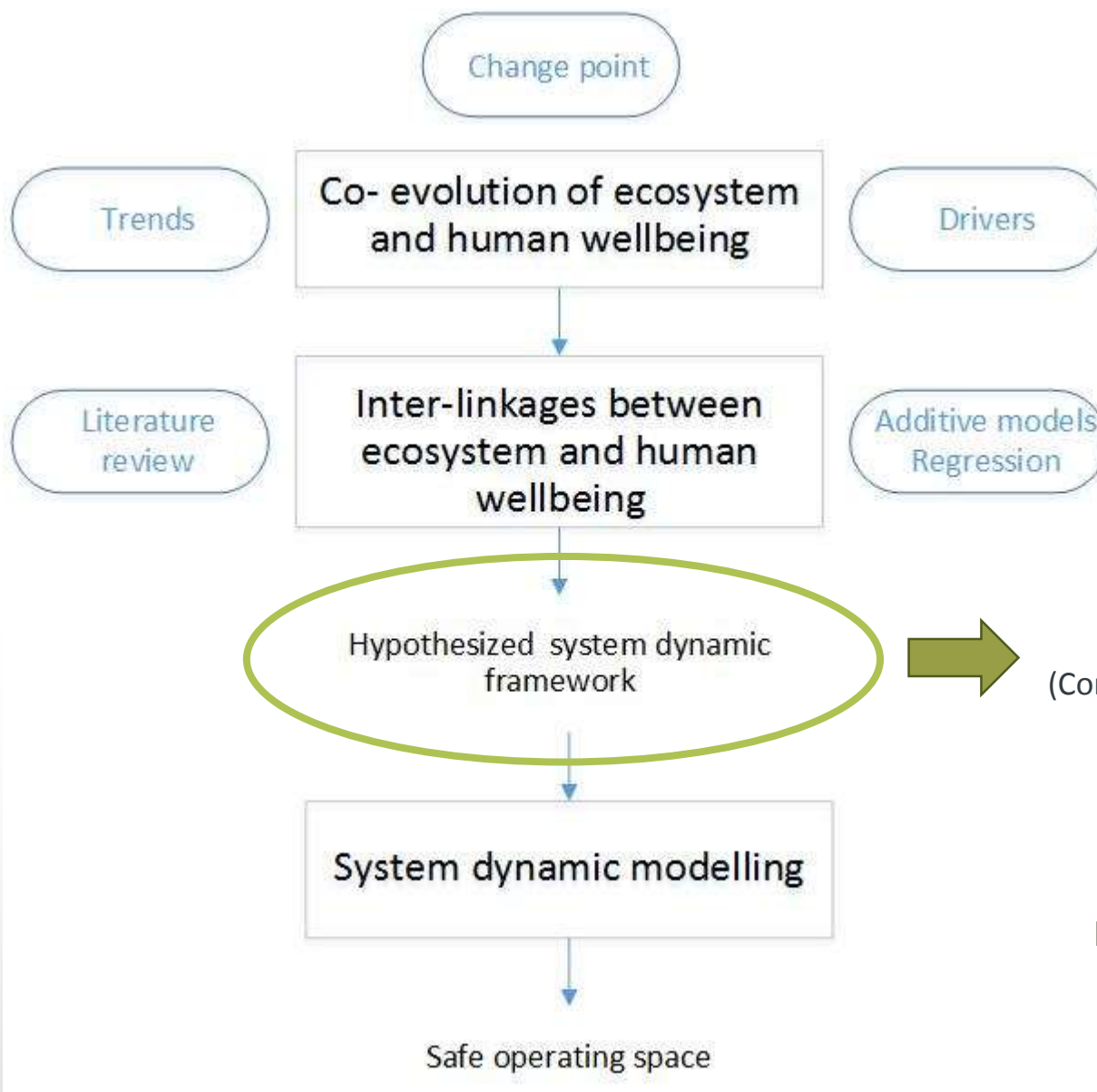
- System : Combination of two or more elements, that are interconnected
- System dynamics (SD) modelling is becoming more commonly used to capture complexities using a systems perspective
- System dynamics provides insight of the behaviour of the system, feedbacks, delay, nonlinearities
 - a. Structure validity - factors and their interrelationships
 - b. Model behaviour validity -model generated behaviour against the real behaviour

Feedbacks, threshold, Long-lasting changes, time lag
between the pressures and impacts





Safe Operating Spaces for Development and Ecosystem Services in Bangladesh



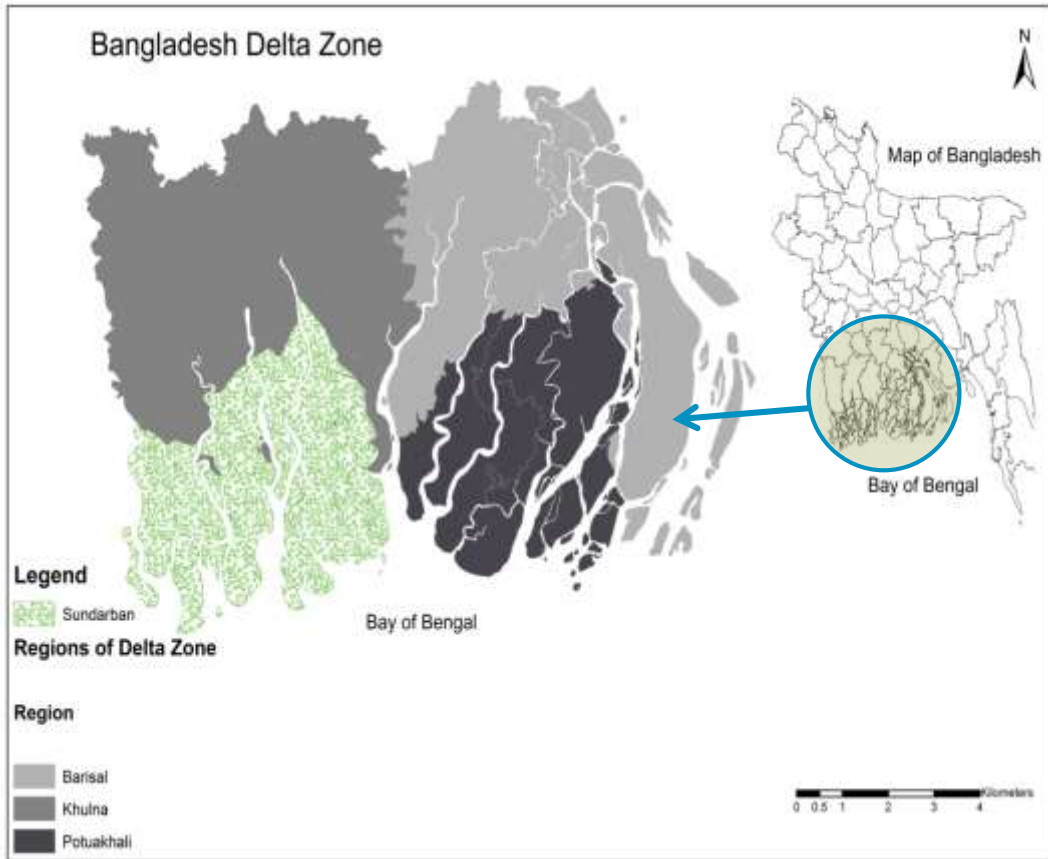
Participatory modelling
(Conceptual model, thresholds, feedbacks)

SANDEE 

ECONOMICS & THE ENVIRONMENT

PhD Dissertation support fund

Study area



Population of ~14 million

Sundarban is the unique and world largest mangrove

Major occupation: Fishing and agriculture

Total coastal ecosystem produces around US\$277 GDP per capita

One of the most vulnerable region to climate change in the world

Other threats: river erosion, flood, cyclone, salinization, high population growth etc.

Objective

- To develop conceptual system dynamic model of ecosystem services and human wellbeing for managing social-ecological system using participatory approach
- **Key research question**

How the stakeholders perceive the structure of socio-ecological system?

Stakeholders: farmers, fisherman's, shrimp farmers, forest people, academician, NGO professional, journalist, government officials

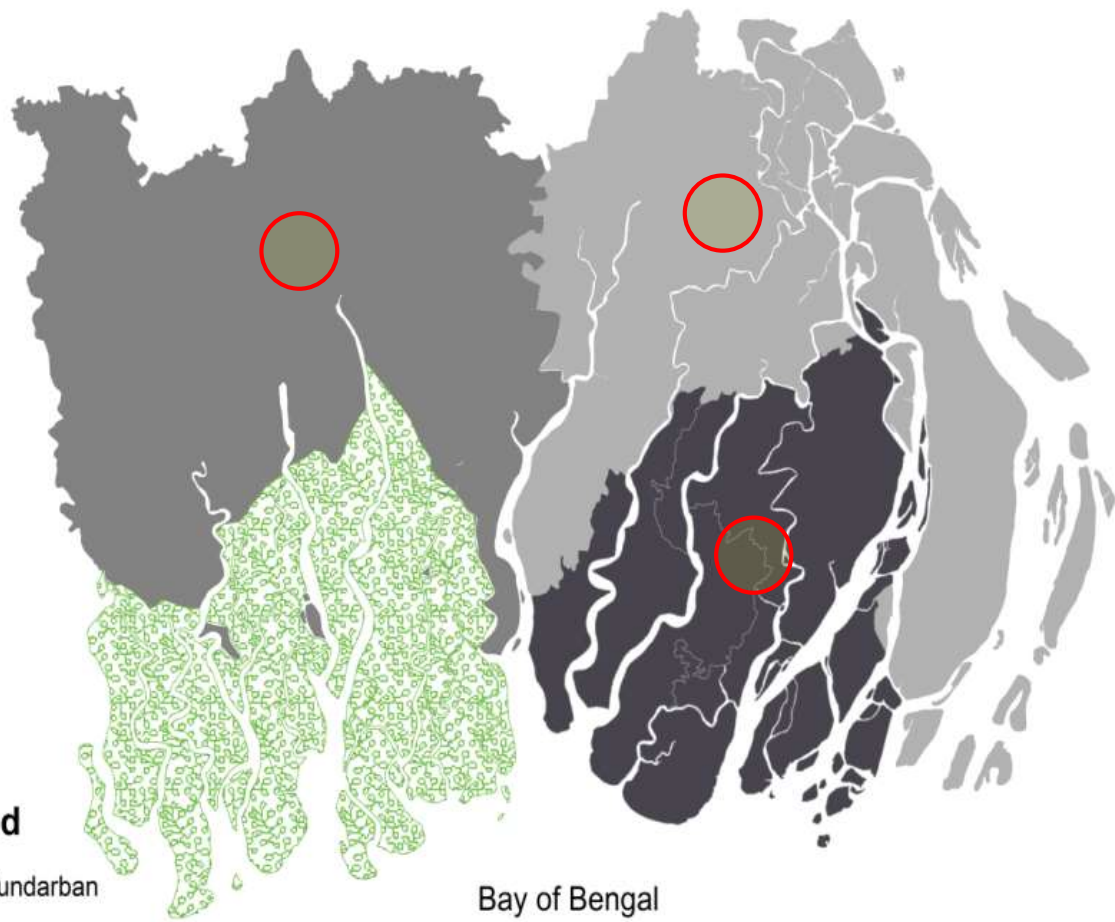
Questions

- What are the key factors that affect their livelihood?
- How do these factors affect their livelihood?
- How do you understand the interlinkages and causality of those factors?
- Is there any threshold point in the social–ecological system or in any individual biophysical process?
- Is there any feedback within the social-ecological system of this region?



~ 50% households are engaged in agriculture, fishery, shrimp farming and mangrove resource collection



Bangladesh Delta Zone



Legend

 Sundarban

Regions of Delta Zone

- Region**
-  Barisal
 -  Khulna
 -  Potuakhali





Focus group discussion in Barishal and Barguna



Workshops in Patuakhali and Khulna

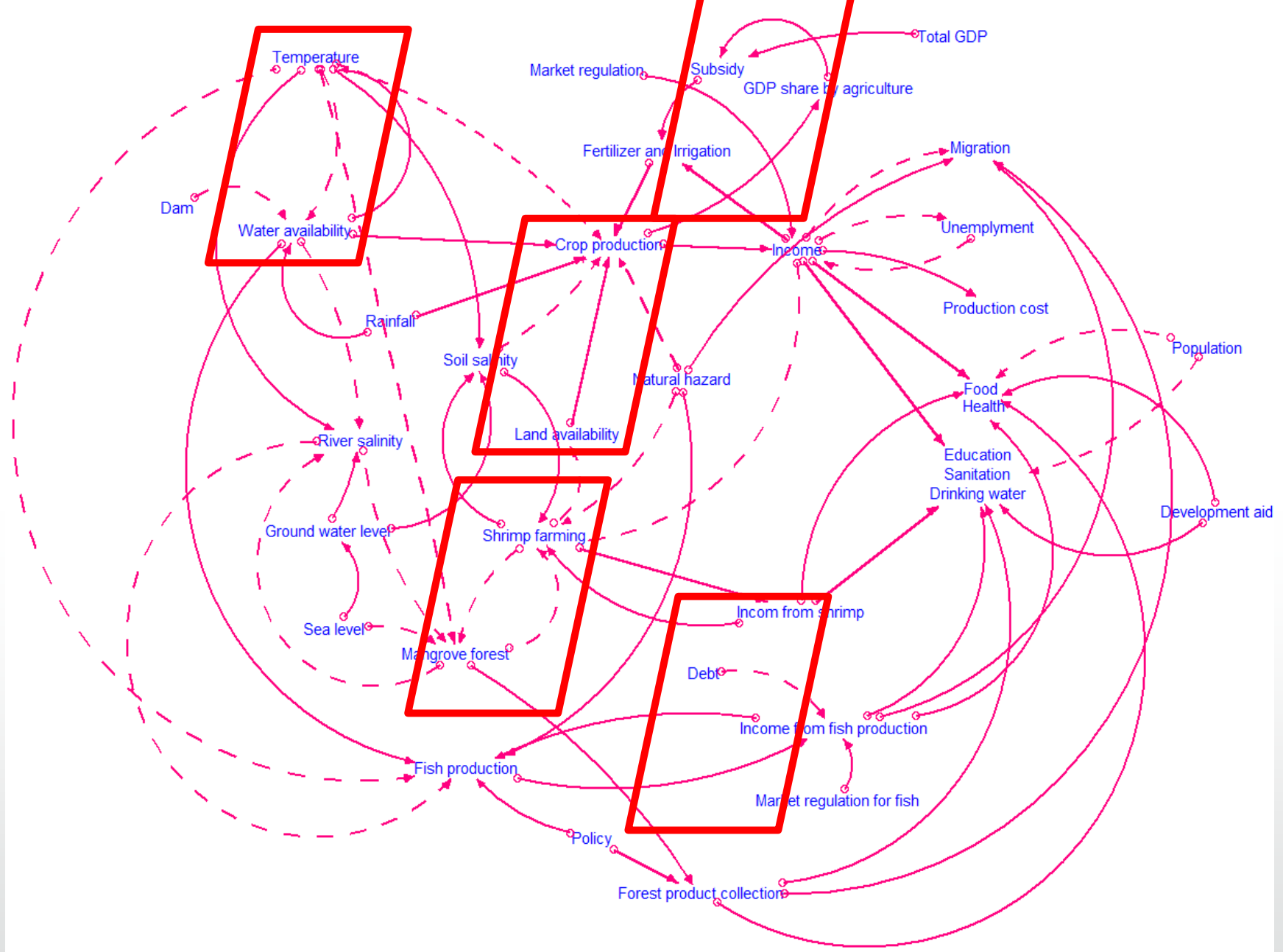


Figure Conceptual system dynamic model for the social-ecological system based on stakeholder's consultation in Bangladesh delta. We combined the information from FGDs with farmers, fisherman, shrimp farmers and forest people, as well as the experts' consultation in workshops. The solid line and dots line depict the positive (+) and negative (-) relationships between the variables.

Thresholds

Livelihood sources	Thresholds	Reference
Agriculture	28° C	Stakeholders & Basak et al., 2012; Basak 2010; Mondal et al., 2001; Mahmud 1998; Karim et a., 1996
	4 dS m ⁻¹	
Forest (mangrove) product	~40,000 dS m ⁻¹	(Islam 2011 and Islam 2008)
	2,000 m ³ /s 25-28° C , 35° C	
Fisheries	27° C to 29° C	Stakeholders
	0-5 ppt	
	~1,500 m ³ /s	
Shrimp	25° C – 32° C	Stakeholders
	7.80-39 dS m ⁻¹	

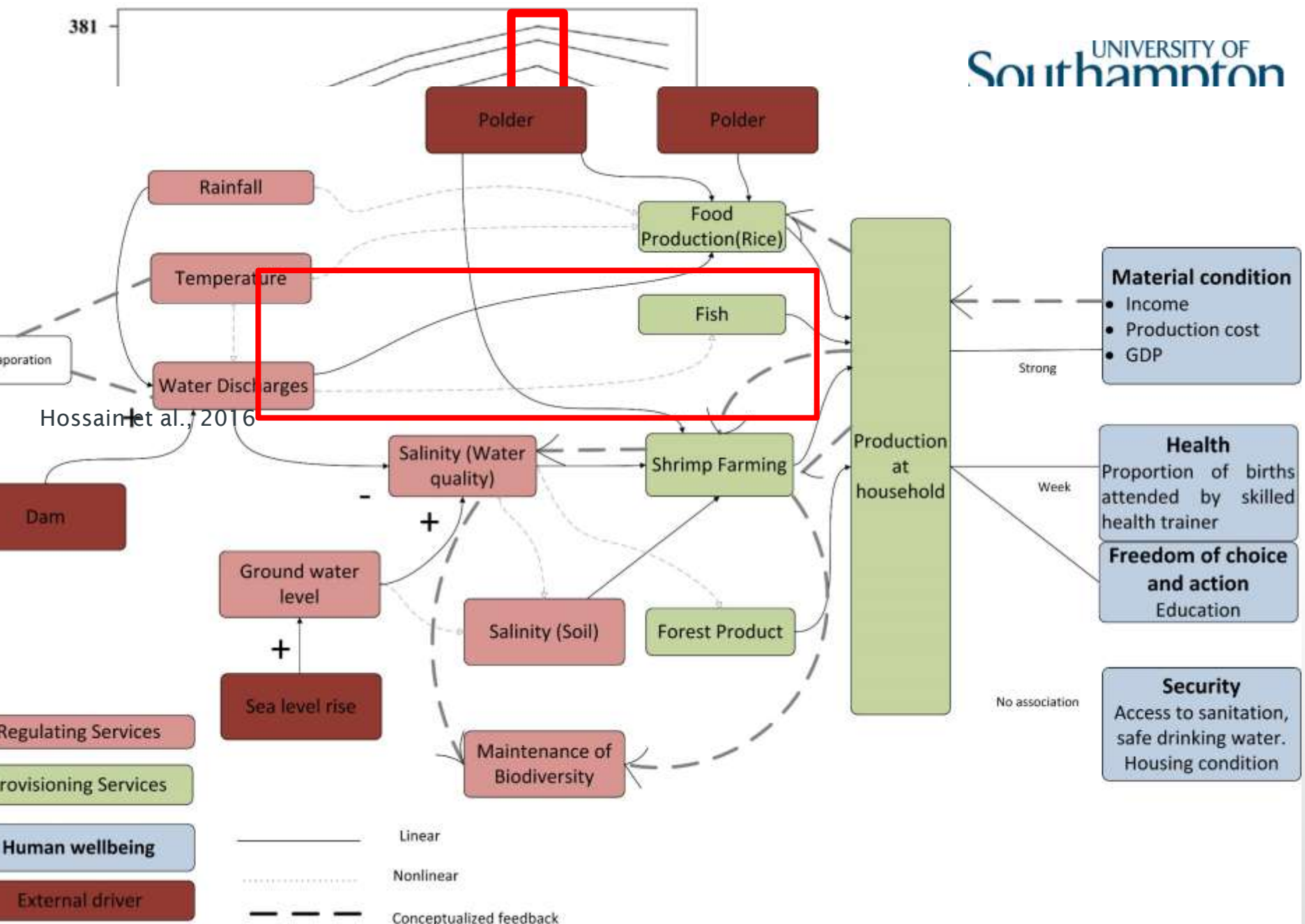


Fig Hypothesized system dynamic framework based on statistical analysis for the social-ecological system in south west coastal Bangladesh Hossain et al., 2016

Conclusion

Evidence of the high dependency of human development (e.g. sanitation, education) on development aid and the dependency of crop production on subsidy - in transition phase as it is adapting well

Proposed subsidy phase out of SDGs (Sustainable Development Goals) in 2030 may pose a risk to the SDGs goal of zero poverty by 2030.

Evidence of:

- The interaction between the slow variables (e.g. temperature, rainfall, water availability)
- Feedbacks and non-linearity (physical thresholds) identified for the slow variables

- may lead to gradual declining of resilience in social and ecological systems- may transgress the safe operating space

Besides the validation and understanding the system:

- Operationalizing the sustainability science concepts in real world,
- Collecting threshold information for the social-ecological system in Bangladesh delta
- Modelling the social-ecological system in data poor areas using participatory approach.
- Can be feed in system dynamic model to simulate the changes in social system in response to the changes in ecological system.

SANDEE working paper : Participatory modelling for conceptual system dynamic model of social-ecological system in Bangladesh delta

Acknowledgements

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**THANK
YOU**

Questions and comments

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